

Science @ Ames

2012 January-February

Volume 1, Number 1

Welcome to the inaugural Science @ Ames Newsletter. This bi-monthly communication is intended to expand the dialogue between senior Science Directorate (Code S) management and its roughly 300 employees beyond the weekly Directorate management staff meetings, the Branch Brown Bag lunches, and periodic all-hands meeting. It will also serve to inform management throughout the Center, and among our NASA sponsors, on the impressive work conducted throughout the Directorate, in supporting NASA's strategic goals. I imagine that recent Directorate retirees will also appreciate receiving monthly updates on research and projects that are implemented on the foundation they helped build. The Science Directorate at Ames includes a wide variety of work across space, Earth and biological sciences. Starting in the March-April issue, we will feature input from one of our nine Branches on a rotating monthly basis, in an effort to better familiarize Directorate staff and Center management on the work that catalyzes our passionate dedication and performance. This first Newsletter will be singularly devoted to a review of the CY2011 highlights. Enjoy, and revel!

Michael D. Bicay, Director for Science
Carol W. Carroll, Deputy Director for Science



The Year In Review: 2011

“No pessimist ever discovered the secret of the stars or sailed an uncharted land, or opened a new doorway for the human spirit.”

Helen Keller (1880-1968)

By any measure, 2011 was a year of remarkable accomplishments for Science @ Ames. It is much too easy to become mired in everyday frustrations, and the motivation for this letter is to catalyze the reader to pause for reflection -- and to recognize an impressive year of achievements directly attributed to Ames science. Without doubt, these feats are a testament to the acumen, dedication and perseverance of Science Directorate employees at NASA's Ames Research Center.

An Era Ends: The Final Shuttle Flight

With the retirement of the Shuttle capping an impressive era of space flight in low earth orbit (LEO), a chapter was closed on Ames' three decades of providing end-to-end design, development and operations of biological science payloads for Shuttle. Eight (!) experiments and payloads aboard the final Shuttle flight (STS-135) in July featured significant Ames involvement. The Space Tissue Loss experiment, a collaboration between NASA and the Department of Defense, investigated how wounds heal in space. This study helped to further the study of tissue regeneration mechanisms, and the development of novel strategies to mitigate crew health risks during spaceflight and for translation to the clinical bedside. A Plant Signaling Experiment studied the effects of microgravity on germination and growth of plant seedlings in space, providing useful new data on potential food production during future long duration space missions. The Micro-2A experiment studied how gravity alters microbial biofilm formation with the goal of developing new protocols to reduce their impact on the operation of spacecrafts and the health of their crew. The Micro-4 experiment used special genetically engineered yeast cells to understand the different responses and physical effects of microgravity by examining which specific yeast strains survive best. The Commercial Biomedical Testing Module-3 marked the 27th time the Ames Animal Enclosure Module was flown onboard a Space Shuttle mission, and evaluated a novel therapeutic countermeasure to prevent flight induced bone loss in mice.



In addition to the STS-135 Shuttle experiments, two new Ames-managed payloads were delivered to the International Space Station (ISS), enhancing the capabilities available to orbiting astronauts. The Ultrasound-2 payload replaced a malfunctioning unit aboard ISS, and allows the crew to conduct diagnostic studies of fellow astronauts. The Forward Osmosis Bag provided a test of technologies needed to convert wastewater into water the astronauts can drink. Finally, Ames provided a student education experiment to study spiders and fruit flies in space. Earlier in the year, the Space Biosciences Division completed the Mouse Immunology-2 payload on STS-133, and managed the treadmill Kinematic Experiment aboard ISS from the Multi-Mission Operations Center at Ames.



While the Shuttle program is now history, Ames' leadership will continue in developing and managing space bioscience payloads. In August of this year, Bion-M1 will launch from Baikonur and deliver an unmanned and automated spacecraft carrying a biological payload into LEO. The rodents on the Bion-M1 spacecraft will be exposed to spaceflight conditions for approximately one month. Continuing a long collaboration between Ames and the Russian Institute of Biomedical Problems in Moscow, Bion-M1 will provide an opportunity to conduct biological and biomedical research on rodent models to determine the fundamental mechanisms of how life adapts to microgravity and then readapts to Earth-normal gravity. Such knowledge provides insight for potential long duration human spaceflight risk mitigation strategies and potential new approaches for Earth-bound biomedical problems. The promise of commercial spaceflight offers additional new opportunities to continue space biology experiments and to make further advances in retiring the risks associated with long-duration spaceflight.

Another Era Begins: SOFIA Conducts Science Flights

While one era drew to a close in 2011, another era started. The *Stratospheric Observatory for Infrared Astronomy* (SOFIA) began to interleave science operations into its continued development, 20 years after the program received the endorsement of the National Research Council in the 1990s Decade Survey for Astronomy and Astrophysics. Carrying a 2.5-meter diameter telescope aboard a Boeing 747 aircraft flying above 40,000 feet, SOFIA will provide a near-space environment for observing the universe at infrared wavelengths. While the aircraft will operate from Palmdale in southern California's Antelope Valley, the science operations will continue to be managed out of Ames.



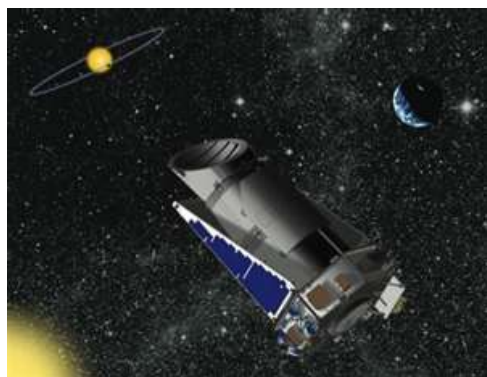
The first two dozen SOFIA science flights yielded publishable results, primarily from two of the observatory's first-generation instruments: a mid-infrared imager and a sub-millimeter heterodyne receiver provided by Germany. Early observations primarily focused on providing

unprecedented spatial and spectral resolution of star formation regions and of the center of our Milky Way Galaxy. In addition, a south Pacific excursion allowed SOFIA to fly into the shadow of Pluto as it occulted a star, providing valuable information of Pluto's tenuous atmosphere. In September, SOFIA executed its first international deployment to Germany to attend a major European air show – while conducting science en route. The six teachers selected by NASA as SOFIA's inaugural Airborne Ambassadors all flew in 2011, taking their experiences back into the classroom.

SOFIA will be grounded for the first eight months of 2012 for previously scheduled aircraft maintenance, avionics upgrades, and continued development activities. Later in the year, science flights will resume and the cadence of SOFIA operations will pick up substantially, as the program aims for an annual rate of 160 flights by 2015. It is expected that SOFIA will continue to add new state-of-the-art instruments throughout its planned 20-year lifetime.

Kepler: Discovering Thousands of New Worlds

Spectacular. Phenomenal. Revolutionary. Select any (or all) of these adjectives to describe the immensely successful *Kepler* mission, which is arguably NASA's most visible science mission these days. A Discovery-class mission selected competitively by NASA in 2002, *Kepler* is rewriting the textbooks – and the Agency's astrophysics narrative. The number of extrasolar planet (“exoplanet”) candidates discovered by *Kepler* blossomed to more than 2300 by the end of the year. Careful follow-on work is likely to show that about 90 percent or more of these candidates will be true planets transiting across the disks of distant stars. More than 200 of these candidates are Earth-sized, and roughly 50 of the candidates are found in the habitable zone of their parent star, where temperatures are commensurate with liquid water.

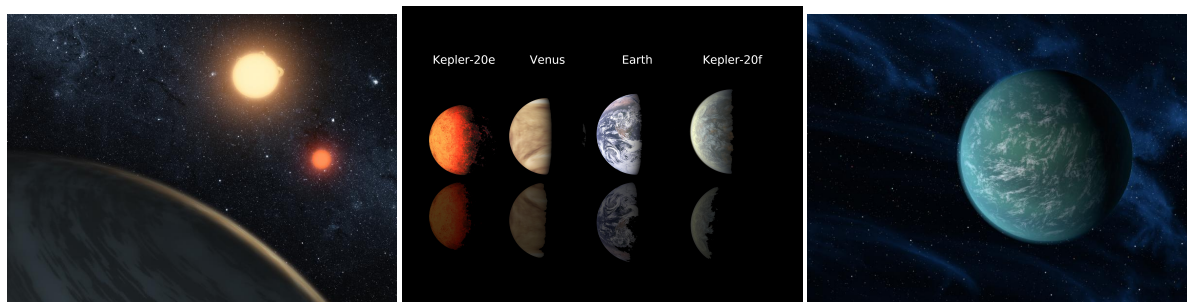


(right)
Cover of 2011 February 3
issue of *NATURE*,
featuring *Kepler*-11 six-
planet system.



During the course of the year, the *Kepler* team reported a series of “firsts,” many of which received wide media coverage around the world: the first rocky planet (January), the first six-planet system (February), the first known planet orbiting around two suns (September), the first near-Earth size planet (November), the first planet in the habitable zone (December), and the first planets smaller than Earth (December). While all of these findings aroused substantial interest among scientists and garner prominent coverage in newspapers and on television, the reader is reminded that these are but milestones on the way to a greater goal. *Kepler* was designed to

answer one fundamental question: What is the frequency of Earth-size planets in the habitable zone (where liquid water could exist) of Sun-like stars? Now in the final year of its 3.5-year prime mission, *Kepler* is well on its way to providing a conclusive answer. Ames recently submitted a proposal for a pair of two-year mission extensions, and we expect to receive the results of this peer-reviewed competition in April.



Artist's depictions of (left) Kepler-16b, the first known circumbinary planet with two parent Suns, (center) Kepler-20e and Kepler-20f, the first two Earth-size planets discovered around a Sun-like star, and (right) Kepler-22b, the first extrasolar planet found in the habitable zone, where liquid water could exist.

Airborne Earth Science Campaigns Take Off

The Earth Sciences Project Office (ESPO) at Ames, responsible for managing NASA's airborne science campaigns, is seeing its business increase dramatically. ESPO has seen its workload increase from an average of about two remote campaigns annually to a half dozen or more each

year. It continues to manage the semi-annual Operation Ice Bridge (OIB), wherein airborne assets are mapping the extent and thickness of polar ice during a gap in satellite coverage that will persist through 2015. ESPO is also managing two of the inaugural Earth Venture campaigns selected by NASA in 2010. The *Airborne Tropical Tropopause Experiment* (ATTREX), featuring Ames science and management leadership, is using NASA's Global Hawk unmanned aircraft to improve global model predictions of feedbacks associated with cirrus, stratospheric humidity & stratospheric ozone at altitudes of 13-18 km. ESPO is also managing the *Hurricane and Severe Storm Sentinel* (HS3) mission on behalf of Goddard Space Flight Center (GSFC), wherein Global Hawks will be used to fly into and over hurricanes. Both of these EV campaigns started in late 2011, and will continue through 2014.



The Earth Sciences Division completed modifications of the small Alpha Jet hosted at Ames, and began flying various airborne instruments during the year. Particularly notable was the Railroad Valley campaign in remote Nevada, where the Alpha Jet Atmospheric Experiment (AJAX) campaign provided important carbon dioxide and methane validation data underneath overflights

by the orbiting Japanese GOSAT mission. Ames won a competition late in the year to use the Alpha Jet for supporting observations of NASA's second *Orbiting Carbon Observatory*, scheduled for launch in 2013.

Another impressive accomplishment by our Earth scientists in 2011 was the successful implementation of the *Coastal and Ocean Airborne and Science Testbed* (COAST) mission. COAST was competitively selected by the Agency as part of its Hands-On Project Experience (HOPE) program, designed to train the next generation of Principal Investigators and Project Managers. COAST used aircraft and ships to conduct ecosystems research in optically complex coastal zones in California's Monterey Bay. Congratulations to PI Liane Guild and PM Jennifer Dungan for bringing this 18-month project to a successful conclusion.

The NASA Earth Exchange

The large number of research highlights in the Directorate conspires against a comprehensive summary in this focused issue, and we urge you to check the March-April Newsletter, wherein research staff (and others) will provide their own highlights from 2011. However, one impressive capability catalyzed by federal stimulus funding two years ago bears inclusion in this Newsletter. Under the direction of Rama Nemani, the NASA Earth Exchange (NEX) was



featured on the 2011 March 29 cover of *EOS*, the transactions of the American Geophysical Union. NEX is a collaborative framework combining state-of-the-art supercomputing (on the NASA Advanced Supercomputer hosted at Ames), various Earth system models, remote sensing data from NASA and other agencies, and a scientific social networking platform to deliver a complete work environment. NEX users can explore and analyze large Earth science data sets, run modeling codes, in a small fraction of the time and effort previously required.

NEX hosts a massive collection of satellite data, as well as global data sets of surface weather records, topography, soils, land cover, global climate simulations and regionally downscaled climate projections. All of these data are integrated with a collection of climate, weather, ecosystem and hydrology modeling codes, along with data processing utilities, database management systems, and analysis/visualization toolboxes. With the volume of Earth science increasing by leaps and bounds, we anticipate that NEX will become a valuable tool in enabling expeditious research capable of informing policy makers in a timely manner.

The First Astrobiology Satellite

The past year also saw the launch and operations of NASA's first astrobiology payload aboard a nano-satellite: *Organism/Organic Exposure to Orbital Stresses* (O/OREOS). Launched from Alaska aboard a USAF Minotaur rocket, the NanoSat carried two payloads, conducting astrobiology and space biology experiments. O/OREOS successfully investigated the stability of organic materials in space and the survival and adaptation of microorganisms, while demonstrating autonomous in situ specimen exposure and detection technologies on a Cube Sat.

This mission served primarily as a technology proof-of-concept, and additional biological science payloads are being developed for upcoming NanoSat secondary payload flights in the coming years.

(Yet More) Awards and Honors

While the variety and scope of Ames flight mission activities has steadily increased over the past few years, it is important to reaffirm that such flights build upon a solid foundation of basic and applied research in space, Earth and biological sciences. While Ames science researchers continue to labor under a less than optimal funding model, they continue to be productive and to win new and prestigious external awards. In 2011, Bill Borucki and Dave Koch won the inaugural Lancelot Berkeley prize awarded by the American Astronomical Society (AAS) for their vision and perseverance in proving the methodology underlying the *Kepler* mission. Dale Cruikshank was elected a fellow of the American Association for the Advancement of Science (AAAS), Scott Sandford was elected as a Fellow of the American Physical Society (APS), and both Jack Lissauer and Kevin Zahnle were elected Fellows of the American Geophysical Union (AGU). These professional societies typically elect a very small fraction (less than 0.5% in the case of AGU) of their members as Fellows each year.

A significant number of prestigious NASA awards were given to Ames science staff in 2011. The Agency's Exceptional Achievement Medal was awarded to Rama Nemani; the Exceptional Scientific Achievement Medal was awarded to Eric Jensen, Tim Lee, Jason Rowe, and Jeff Scargle; the Exceptional Public Service Medal to Natalie Batalha; and the Exceptional Service Medal was given to Mike Craig and to Jessie Dotson.

NASA Silver Snoopy Awards, the prestigious human spaceflight awards voted upon by astronauts, were given to civil servants Tom Luzod, Nicki Rayl and Kenny Vassigh, and to Lockheed Martin partners Paula Dumars, David Heathcote, Karin Perkins, Kevin Sato and Marianne Steele.

The NASA Software of the Year Award was granted to the *Kepler* Science Operations Center, led (at the time) by David Pletcher. The NASA Commercial Invention of the Year honor was awarded to David Blake and Philippe Sarazin for their design and development of an innovative powder-handling device for analytical instruments. We would be remiss if we did not mention that Dr. Blake's CheMin instrument was launched aboard the *Mars Science Laboratory* in November and will provide definitive chemical and mineralogical analysis of samples collected by the *Curiosity* rover after the Mars landing in August 2012.

Science Directorate staff received the Center's highest accolades in 2011. After a decade-long gap, the Center announced the selection of two new Ames Fellows in 2011, including Lou Allamandola for his leadership of the Astrochemistry Laboratory, which has elucidated the nature of hydrocarbons in the interstellar medium. Mark Marley was selected as a winner of the H. Julian Allen Award for best publication by an Ames researcher over the previous two years. Congratulations are offered to Tony Colaprete, Jeff Scargle and Marilyn Vasques for promotion

to the GS-15 level, and to Jennifer Dungan, Tom Luzod and Nicki Rayl for their promotion to GS-14.

In addition to individual awards, NASA Group Achievement Awards with significant Science Directorate involvement included: the 4STAR Development Team, the Adaptation and Climate Change Group, the Astrochemistry Laboratory, the Forest Carbon Team, the [Hurricane] Genesis and Rapid Intensification Processes Team, the Global Hawk Pacific Mission Team, the *Hayabusa* Re-Entry Airborne Observation Project, the *Kepler* Awareness/Education/Public Outreach Team, the *Kepler* Mission Operations Team, the *Kepler*-Pleiades Science Operations Center Pipeline Processing Team, the LCROSS Mission Operations Systems and Ground Data Team, the Micro-2A Payload Team, the Mouse Immunology Team, the O/OREOS Nanosatellite Science and Engineering Group, the SOFIA Initial Science Flight Team, the Space Tissue Loss Payload Team, the Terrestrial Observation and Prediction Systems Team, and the TROPIC-2 Payload Team.

Science researchers in the Directorate continued to build upon an impressive foundation of work in 2011. With about 200 research scientists in the Directorate, half of which are civil servants, the breadth and depth of highlights exceeds the available space in the letter. The March-April issue of the *Science @ Ames Newsletter* will include employee-submitted highlights from 2011, many of which are likely to feature many research findings. Stay tuned.

Comings and Goings

Sid Sun returned to the Directorate in 2011 to become the Space Biosciences Division Chief, with Debra Reiss-Bubenheim now serving as his Associate Chief. We warmly welcome Sid back from his dual sojourn to Codes P and H. David Bergner, who had previously served as Division Chief, and later as the Division's Chief Technologist, retired late in the year. Paresh Bhavsar (formerly Code T) became the new Branch Chief for Flight Systems Implementation, taking over for David Pletcher, who had assumed leadership earlier in the year when Cecilia Wigley stepped down.

Steve Howell was hired as the Kepler Deputy Project Scientist, joining the Astrophysics Branch from the National Optical Astronomy Observatories. Bernie Luna joined ESPO to help manage the increasing number of Earth Science airborne campaigns, transferring from the Bioengineering Branch. Dana Bolles joined the Space Biosciences Division, transferring from Code V, and former contractor Jhony Zavaleta joined the Atmospheric Sciences Branch. In the Directorate front office, Lori-Ann Munar decided to pursue another opportunity at the Center, and we were fortunate to have Marlowe Primack take her place.

David Koch, Deputy Science Principal Investigator for *Kepler*, retired this past year, although he remains engaged in the mission from his Wisconsin home. Michael Way, who has been on detail at the Goddard Institute for Space Studies for a few years, elected to become a permanent GSFC employee. Other Directorate departures in 2011 included: Tony Strawa (to Code V), Mike Gaunce (to Code A), Mike Skidmore (to Code P), and Kenny Vassigh (to Code D). In addition,

Jay Skiles is on detail from the Biospheric Sciences Branch to Code A, while Dave Jordan is on detail from Code RE to ESPO, where is managing the ATTREX mission.

Sadly, we bid a final farewell to two friends in 2011. While not formally a member of the Science Directorate, Dr. Baruch (Barry) Blumberg passed away on April 5, while attending a conference at Ames Research Center. Winner of the 1976 Nobel Prize in physiology, and president of the American Philosophical Society, Barry was also the inaugural Director of the NASA Astrobiology Institute at Ames from 1999-2002. Many of his colleagues and friends in the Directorate will sincerely miss his gentlemanly manner and scholarship. Lupe Sanchez, the administrative assistant to the Astrophysics Branch, passed away on November 12, after losing a long battle with liver disease.

The Year Ahead

As we look ahead to 2012, the potential exists for another blockbuster year for Science @ Ames. The final year of *Kepler's* prime mission will be particularly sensitive to discovering Earth-size (and smaller) planets in roughly one-year orbits, and therefore presumed to be capable of having liquid water. In April, we hope to hear from NASA Headquarters that a mission extension has been approved. The first cycle of SOFIA observing proposals will be reviewed and selections will be made for flights starting after the planned downtime for maintenance and aircraft upgrades. In addition, NASA will announce the selection of a handful of second-generation science instruments. One of the instrument proposals was submitted by Ames.

ESPO will conduct OIB campaigns in the Arctic in March through May from bases in Greenland and Alaska, and in Antarctica (from Chile) in October-November. The second series of flights for the HS3 mission will launch from Wallops Flight Facility in August-September. The Seagrass mission will utilize the Ames SIERRA unmanned aerial vehicle to measure conduct an assessment of carbon dynamics in seagrass and coral reef biomes off the coasts of Florida and Trinidad & Tobago in a pair of campaigns.

A major new ESPO-managed airborne campaign will be implemented in Thailand in late summer. The Southeast Asia Composition, Cloud, Climate Coupling Regional Study (SEAC4RS) will address key questions regarding the influence of Asian emissions on clouds, climate, and air quality. Science observations will focus specifically on the role of the Asian monsoon redistribution in governing upper chemistry. Satellite observations suggest a strong impact of the Asian Summer Monsoon on (TTL) composition and a direct relationship to surface sources including pollution, biogenic emissions, and biomass burning. Attention will also be given to the influence of biomass burning and pollution, their temporal evolution, and ultimately impacts on meteorological processes which in turn feed back into regional air quality. With respect to meteorological feedbacks, the opportunity to examine the impact of polluting aerosols on cloud properties and ultimately



dynamics will be of particular interest. SEAC4RS is a joint collaboration between NASA, the National Science Foundation and the Naval Research Laboratory.

In addition to the Bion-M1 collaboration with Russia mentioned earlier, Ames space biosciences begins the era of commercial spaceflight by managing several payloads to be launched aboard a Dragon supply capsule to ISS on a SpaceX Falcon rocket. The first one will be the Micro-5 experiment, which will follow up earlier results demonstrating that the space flight environment increases the virulence of bacteria. This payload will take the next step and examine how this increase directly affects the immune response of a host organism. More specifically, this experiment will investigate the effects of the space flight environment on host-pathogen interactions and the ability of the host to mount an immune response. Ames is also developing several new ISS research facilities, including the Advanced Rodent Habitat and a new Cell Culture Module. Both of these systems will greatly expand the opportunities for conducting space biology research in microgravity.

Two “new” research initiatives are starting in 2012, with the support of NASA Headquarters.

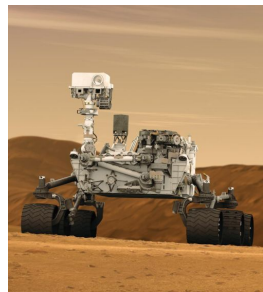


The Office of Chief Technologist funds the Synthetic Biology Program at Ames, where it is managed out of the Science Directorate. This program, initially funded at \$2.5M annually, will apply the tools of synthetic biology to address some of the issues the Agency must surmount before embarking on long-duration spaceflight. Ames is advertising for a new hire that will play a big role in helping define the trajectory of this interdisciplinary program. The Planetary Science Division at Headquarters has agreed to establish a Mars Climate Modeling Center (MCMC) at

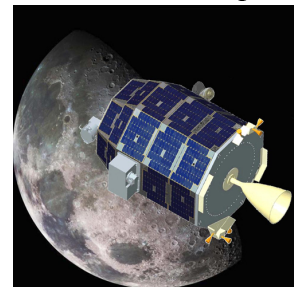
Ames. This initiative capitalizes on many years of research conducted at Ames, and will lead to a sophisticated Web-based portal for enabling international research, while potentially serving as a valuable tool for the manned spaceflight program.



In early August, many planetary scientists (and others!) will be on the edge of their seats awaiting the entry, descent and landing of MSL in Gale Crater on Mars. The Ames-designed CheMin will be one of the workhorse instruments on the *Curiosity* rover. The *Lunar Atmosphere*



and Dust Environment Explorer (LADEE), an Ames-led lunar orbiter, will rapidly move through integration and testing this coming year, in advance of its launch in mid-2013. Tony Colaprete is the Principal Investigator for the LADEE ultraviolet/visible spectrometer instrument. LADEE will fly in low orbit to study the tenuous lunar exosphere, and to study



the extent of lofted dust at the terminators. Ames has significant roles in a heliophysics Explorer mission schedule to launch in December 2012. The *Interface Region Imaging Spectrograph* (IRIS), led by Lockheed Martin in Palo Alto, will trace the flow of energy and plasma through

the Sun's chromosphere and transition region, and into the solar corona. Ames will lead IRIS operations, flight operations, and ground systems development.

Finally, most of the Earth Sciences Division and many of the SOFIA Project personnel have begun moving into "Sustainability Base," the new LEED Platinum building near the front gate and across the traffic circle from the Center's Administration building. This building is – at least for now – the 'greenest' building in the federal government. Using NASA innovations originally engineered for space travel and exploration, this fifty thousand square foot building provides needed office space, while serving as a showcase for NASA technology and an exemplar for the future of buildings.



In summary, 2011 has been an exemplary year for Science @ Ames. We continue to successfully implement more projects and programs, while building upon a solid foundation of world-class research. With the budgetary environment providing increasingly stiff headwinds in 2012 and beyond, this Center's reputation for providing high-quality products at reasonable (and predictable!) cost will resonate with our sponsors.

Circling back to the opening of this Newsletter, we encourage Science Directorate staff to recognize the impressive work you accomplished in 2011 -- and to be optimistic about the secrets of the Universe yet to be discovered, the lands yet to be charted, and the doorways yet to be opened. Ad astra.